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United States Department of Agriculture  
Agricultural Marketing Service

Influence of Seasonal Distribution of Rainfall  
and Temperature on Yield of Corn\*



Relationships between corn yields and the weather factors of rainfall and temperatures are presented for eight States in and adjacent to the Corn Belt. The method of analysis used was the regression integral and a system of orthogonal polynomials as devised by R. A. Fisher an eminent English statistician. This method has been found to be an effective method in weather-crop studies. The method eliminates the discontinuities ordinarily introduced in weather-crop correlations by breaking the growth season into arbitrary short periods. The results for a location can be presented as a simple continuous curve varying with time. The simple expression of the results permits an application readily to both crop estimating and to understanding the relationship between weather and the growth and development of the crop. It permits a convenient comparison of results between locations.

Year to year variations in the yield of corn on experimental plots at agricultural experiment stations have been studied in relation to rainfall and temperatures as recorded at the experiment stations. Data from Pennsylvania, Maryland, Ohio, Illinois, Iowa, Missouri, Nebraska and Kansas were studied through the cooperation of the Agronomy Departments at these various institutions. In nearly every instance the results show that not only is the total amount of rainfall during the season important but also that the dis-



tribution of the rainfall during the season is extremely important. The results for rainfall are in close agreement with results of other workers in that July and early August rainfall is most important for high yields of corn. While this is true, it is pointed out that weather records are obtained throughout the season and therefore the relationships for the entire season may just as well be established and used.

From the results of the studies it may be stated in general that throughout the Corn Belt and adjacent territory, especially the southern parts, an inch of rainfall above average during the time of maximum influence, usually in July and/or August, increases the yield of corn nearly three bushels per acre. The time of the maximum effect is conditioned by the needs of the crop in conjunction with the amount of rainfall normally received. Before and after the time of maximum returns, the effect of an additional inch of rainfall gradually drops to zero and possibly becomes detrimental. The exact effect in bushels of corn per acre of additional rainfall is conditioned by the level of yields and by cultural conditions. These summary statements are based upon Figure 3 and other supporting evidence.

The relationships between maximum temperatures and corn yields are even more informative than those for rainfall. Less information has previously been available in the case of temperature and the relationships found are also more significant statistically than those for rainfall. It seems apparent that temperatures are more important in determining corn yields than rainfall. However, the two weather factors were found to be closely interrelated with the yield of corn.





Summarizing the effect of temperature, above average maximum temperatures become detrimental in June at all locations studied and gradually reach the period of greatest reduction to yield sometime in July or August. The time of greatest detriment to yields does not differ widely over the whole territory studied. The extent of the decrease in yields at this time would be from two to three bushels per 10 degrees above average in maximum temperatures. The extent depends upon the general level of the yields. For corn the optimum maximum temperatures appear to be about 81 or 82 degrees under the moisture conditions prevailing at the locations studied.

The cultural conditions under which the corn was grown appeared to considerably influence the relation between rainfall and corn yields. The cultural conditions did not appear to much influence the relation between temperature and corn yields. Since the corn at the different locations did grow under different cultural conditions, the pattern across the Corn Belt is less consistent for the effect of rainfall than it is for temperature. The results on the effect of temperature during the season are logical as is also the pattern of the effect from station to station across the Corn Belt.

\* Abstract of paper presented at the Kansas Weather-Crops Seminar at Kansas City, November 2, 1940, by Floyd E. Davis, Agricultural Marketing Service.





Effect in  
Bushels  
per Acre.

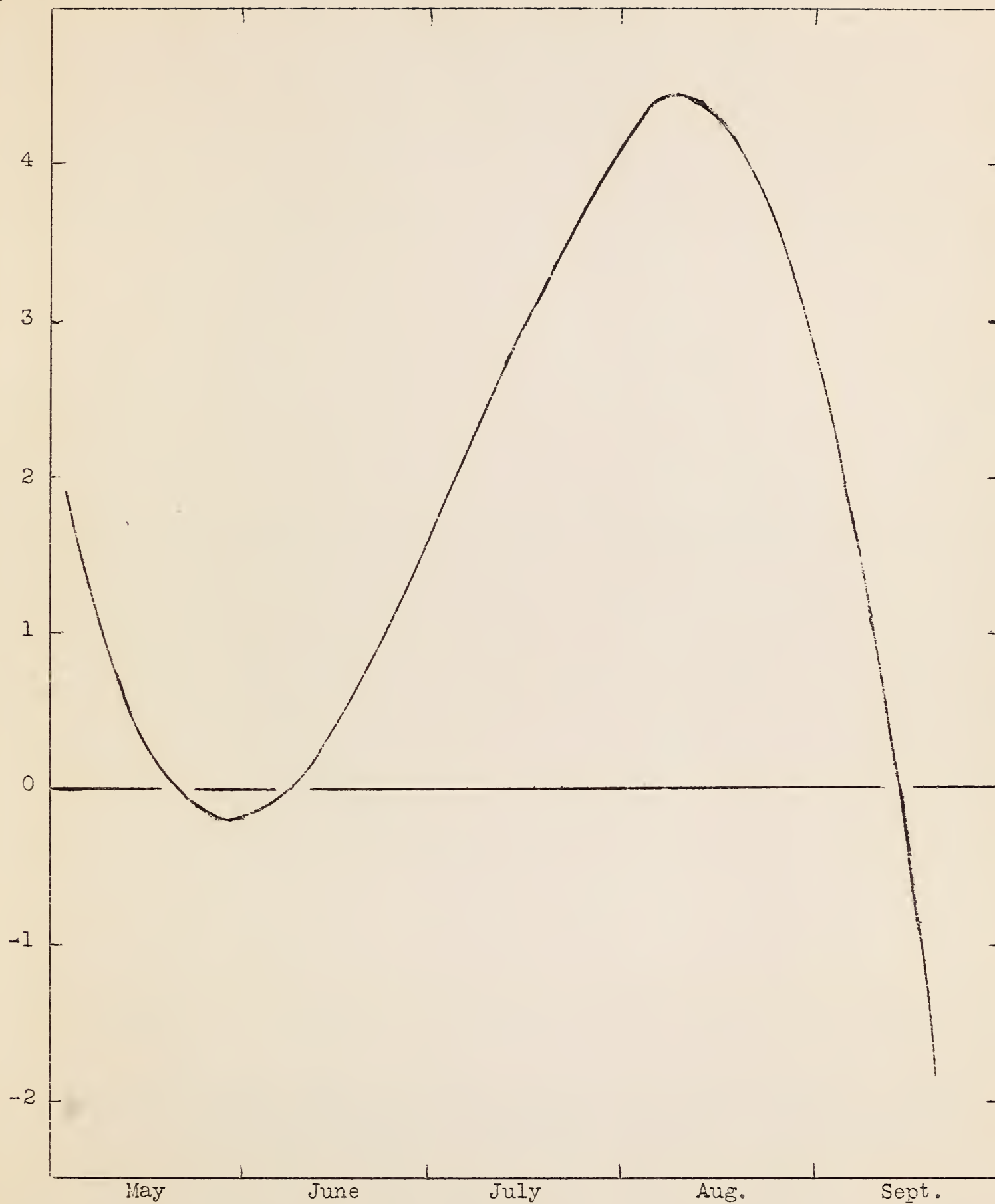
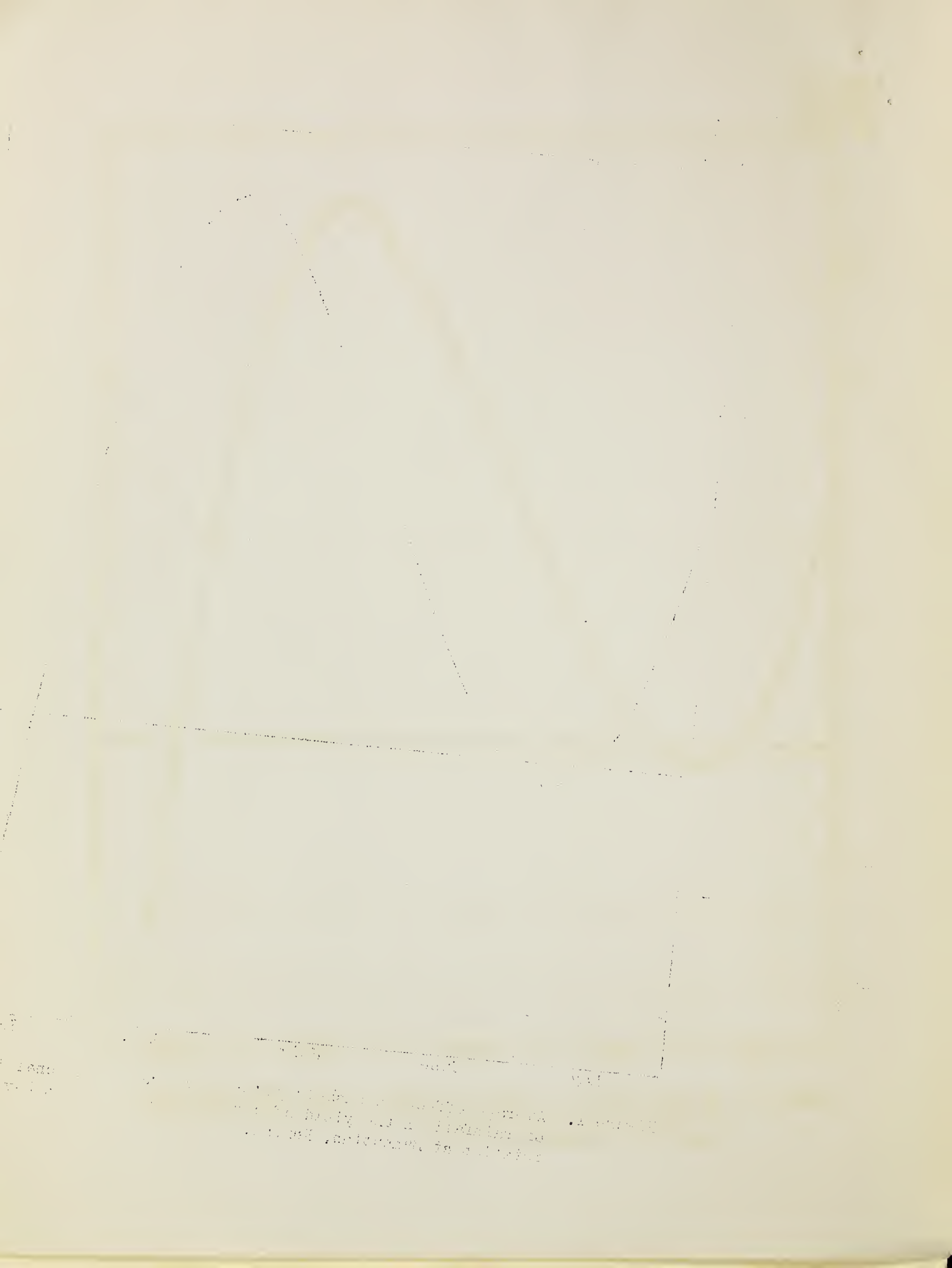


Figure 1. Average effect in bushels per acre of each additional inch of rainfall on the yield of corn on check plots in 3-year rotation at Manhattan, Kansas.



Effect in  
Bushels  
per Acre.

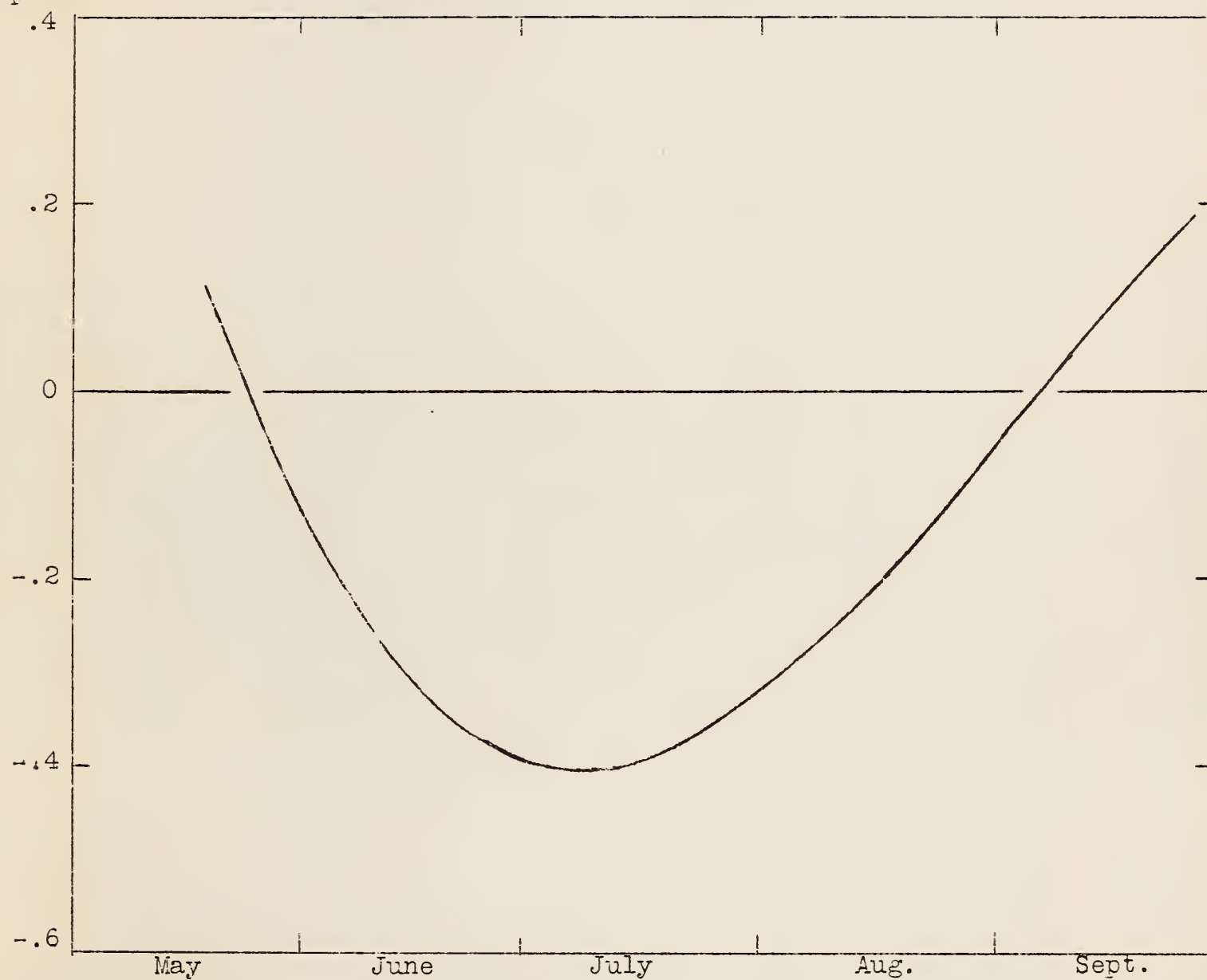


Figure 2. Average effect in bushels per acre of each degree in maximum temperature above the average on yield of corn on check plots in 3-year rotation at Manhattan, Kansas.



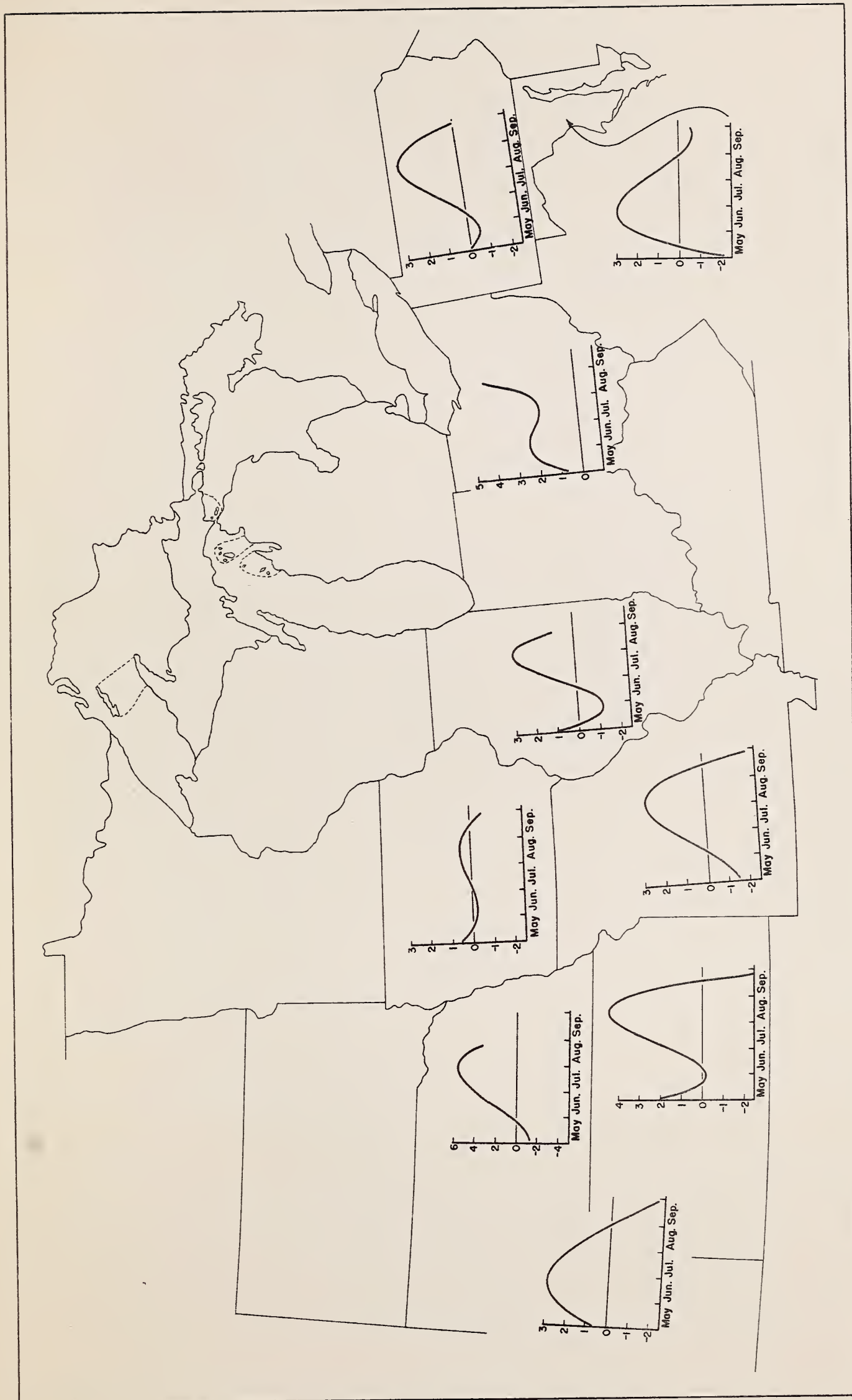


Figure 3. Average effect in bushels per acre of each additional inch of rainfall on yield of corn on Agronomic Plots at several locations.





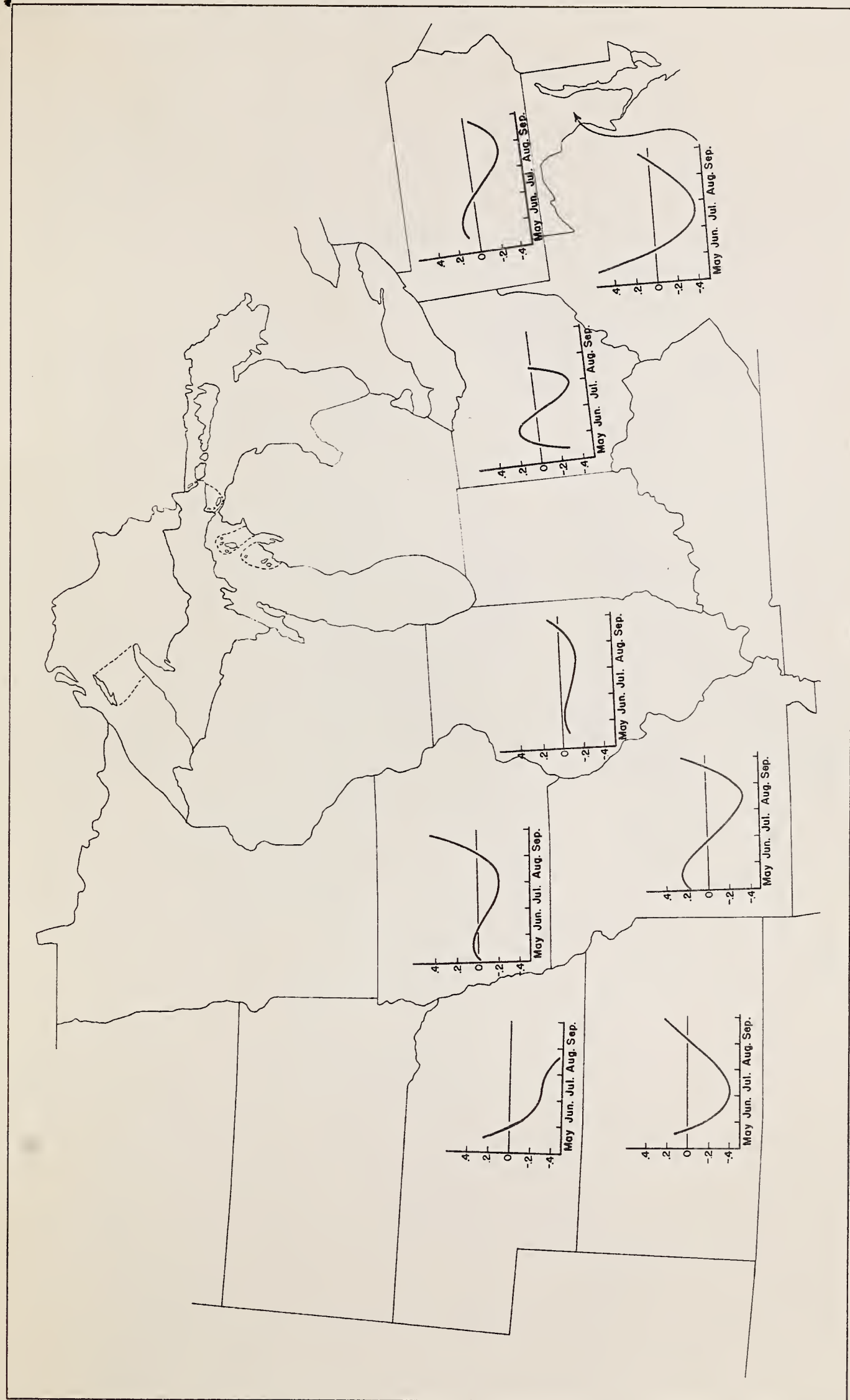


Figure 4. Average effect in bushels per acre of each degree in maximum temperature above the average on yield of corn on Agronomic Plots at several locations.

